USER-PROPELLED RIDING TOYS AND METHODS

RELATED APPLICATIONS

This application claims priority to United States Provisional No. 60/438,230, entitled "Self-Propelled Scooter with Quick Attachment Parts," filed on January 6, 2003; United States Provisional No. 60/438,231, entitled "Self-Propelled Skateboard Without Pedal," filed on January 6, 2003; and United States Provisional No. 60/440,101, entitled "Self-Propelled Scooter with Quick Attachment Parts," filed on January 16, 2003, all of which are incorporated by reference.

FIELD OF THE INVENTION

The invention relates generally to the field of sports, games, recreation, and particularly relates to user-propelled toy vehicles on which a user stands.

BACKGROUND OF THE INVENTION

Conventional toys such as skateboards and scooters require a user to propel the toy forward by using at least one foot along the ground to generate forward motion while keeping the other foot on the toy without touching the ground. Generally, at least one of the user's feet is positioned on the toy at approximately a right angle to the forward direction of travel by the toy. One foot on the toy steers the direction of the toy while the other foot engages the ground and pushes the toy to propel the user and toy forward.

The speed and direction of these toys can be changed by shifting the user's weight towards either of the lateral sides of the toy. Since a weight shift in a lateral direction does not directly aid in the toy's forward motion or propulsion, the lateral weight shift is

an inefficient use of the user's energy. Next, the full power of the user's leg muscles cannot be achieved. For instance, when the user's leg contacts the ground, the user's leg applies a force against the ground. However, the force is applied to the ground when the end user's leg is at approximately a right angle. This is mechanically inefficient since the maximum forward power only lasts a relatively short time, at the end of each push. Further, the toy's forward motion tends to "skew" the user's body as the user leans laterally towards the sides of the toy to push in a backward direction against the ground with his or her foot.

These toys are inefficient and do not allow the user to attain relatively high speeds and accurate maneuvering. In some cases, the user becomes tired and has to stop to rest. In other cases, the user becomes disinterested and the user stops playing with the toy. Examples of these conventional toys are self-propelled scooters and skateboards. Pedal-based skateboards have numerous disadvantages including: (1) Such toys are inconvenient for users to manipulate the skateboards for jumping or turning, as curves can easily be negotiated and the skateboard easily handled only if use of the pedals is interrupted; (2) such toys are uncomfortable for the users using their feet to drive the skateboards; (3) such toys demand the use of pedals, and look "complicated" to operate and ride, and thus might not be as fun to use; and (4) such toys do not provide users the feeling of "surfing" during use of the toy on the ground.

Therefore, a need exists for improved user-propelled riding toys and methods.

SUMMARY OF THE INVENTION

This invention is a user-propelled riding toy. A platform on which a user stands is supported by a steering mechanism that transfers a directional force from the platform, and a geartrain mounts to one or more wheels. The geartrain is adapted to receive a downward force from the platform, and translate a portion of the downward force into a rotational force on the wheels. The geartrain also provides an upward return force acting on the platform, and translates a directional force into a lateral force acting on the wheels. The platform is propelled forward direction by the rotational force on the wheels. Lateral forces cause two sets of wheels to pivot in opposite directions, and thereby directionally steer the platform.

According to another aspect of the invention, a propulsion device includes a platform to support the user, wheels, and a hinge joint. The hinge joint transfers a downward force from the platform by pivoting downward in response to a downward force from the platform, and then pivoting upward in response to a return force. A geartrain is associated with the hinge joint and drives a set of wheels in one direction only.

According to yet another aspect of the invention, a scooter includes a frame, pedals adapted to support a user, wheels, and a geartrain mounted to the wheels. The geartrain is adapted to receive a downward force from the pedals, translate a portion of the downward force into a rotational force acting to rotate the wheels in one direction only, and provide an upward return force for the pedals.

Objects, features, and advantages of various embodiments of the invention include:

(1) Improved apparatuses and methods for propelling a toy, such as a skateboard or a scooter; and

(2) Improved apparatuses and methods for directionally steering a toy, such as a skateboard or a scooter.

Other objects, features and advantages of various embodiments according to the invention are apparent from the other parts of this document.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side sectional view of an exemplary embodiment of an apparatus in accordance with the invention.

FIG. 2 is a detail view A-A of a transmission assembly of the apparatus shown in FIG. 10.

FIG. 3 is a perspective view of a transmission assembly for the apparatus shown in FIG. 1.

FIG. 4 is a perspective view of another transmission assembly for the apparatus shown in FIG. 1.

FIG. 5A is a bottom schematic view of the apparatus shown in FIG. 1, with the wheels oriented for moving the apparatus in a forward direction.

FIG. 5B is another bottom view of the apparatus shown in FIG. 1, with the wheels oriented for turning the direction of the apparatus.

FIG. 6 is a side sectional view of a second embodiment of an apparatus in accordance with the invention.

FIG. 7 is a perspective view of a third embodiment of an apparatus in accordance with the invention, with a portion of the footboard cutaway to show the underlying transmission assembly and support.

FIG. 8 is a side view of the apparatus shown in FIG. 7 with a downward force being applied to the front portion of the apparatus.

FIG. 9 is a side view of a fourth embodiment of an apparatus in accordance with the invention.

FIG. 10 is a front sectional view of the apparatus shown in FIG. 9.

FIG. 11 is a rear sectional view of the apparatus shown in FIG. 9.

FIG. 12 is a side view of the apparatus shown in FIG. 9, with a pivoting range of motion shown for each transmission assembly.

FIG. 13A is a bottom schematic view of the apparatus shown in FIG. 9, with the wheels oriented for moving the apparatus in a forward direction.

FIG. 13B is a bottom schematic view of the apparatus shown in FIG. 9, with the wheels oriented for turning the direction of the apparatus.

FIG. 14 is a perspective view of a fifth embodiment of an apparatus in accordance with the invention.

FIG. 15 is a side sectional view of a transmission assembly for the apparatus shown in FIG. 14.

FIG. 16 is an overhead sectional view of the transmission assembly for the apparatus shown in FIG. 14.

FIG. 17 is a cross sectional view of the transmission assembly for the apparatus shown in FIG. 14.

FIG. 18 is a sixth embodiment of an apparatus in accordance with the invention.

FIG. 19 is an overhead sectional view of a transmission assembly for the apparatus shown in FIG. 18.

FIG. 20 is a perspective view of a seventh embodiment of an apparatus in accordance with the invention.

FIG. 21 is a perspective view of an eighth embodiment of an apparatus in accordance with the invention.

FIG. 22 is a scooter train in accordance with the invention.

FIG. 23 is a flowchart for an exemplary embodiment of a method in accordance with the invention.

FIG. 24 is a flowchart for another embodiment of a method in accordance with the invention.

DETAILED DESCRIPTION OF SPECIFIC EMBODIMENTS

The present invention relates to user-propelled toy such as a skateboard or scooter, which utilizes power generated by movement of a user supported by a platform while keeping both feet on the platform without touching the ground. While the embodiments shown in the embodiments relate to skateboards and scooters, one skilled in the art will recognize the applicability of the invention to other toys, vehicles, and/or platforms that can support a user.

FIGs. 1, 2, 3, 4, and 5A-B illustrate an exemplary embodiment of an apparatus in accordance with the invention. FIG. 1 is a side view of the exemplary embodiment of the apparatus. FIG. 2 is a detail view A-A of a rear transmission assembly of the apparatus shown in FIG. 1. The footboard **1000** is adapted to support a user on an upper surface. The footboard **1000** shown is similar to a footboard of a conventional skateboard. Typically, the footboard **1000** is positioned in a substantially horizontal orientation. In this example, the footboard **1000** is shown with a leading edge **1002** that arcs slightly upward from a longitudinal axis **1004**, and a trailing edge **1006** that also arcs slightly upward from the longitudinal axis **1004**. The configurations of the leading edge **1002** and trailing edge **1006** assist a user with directional control and/or braking of the apparatus. Other apparatuses can have footboards with other configurations in accordance with the invention.

The apparatus shown also includes two geartrains or transmission assemblies **1008, 1010** adapted to translate a downward force from the footboard **1000** to a rotational force. Greater or fewer numbers of geartrains or transmission assemblies can be used in accordance with the invention. As shown in FIG. 1, each of the transmission assemblies **1008, 1010** includes a respective casing **1012, 1014** hinge joint **1016, 1018**, rack **1020, 1022**, helical compression spring **1024, 1026**, and a set of wheels **1028, 1030**. The casings **1012, 1014** each house a series of gears (shown in FIGs. 3 and 4) that translate the vertical movement of the racks **1020, 1022** to respective rotations of the sets of wheels **1028, 1030**. The hinge joints **1016, 1018** are each adapted to transfer force between the footboard **1000** and the respective racks **1020, 1022** and further adapted to mount the transmission assemblies **1008, 1010** to the lower surface of the footboard

1000. The racks **1020, 1022** each extend vertically upward from the respective casings **1012, 1014** towards the lower surface of the footboard **1000**, and each rack **1020, 1022** rotates at least one gear inside the respective casing **1012, 1014**. An upper end of each rack **1020, 1022** includes a respective head **1032, 1034** that travels vertically with respect to a respective mounting cup or hinge joint mount **1036, 1038**. In the embodiment shown, the heads **1032, 1034** are retained within the hinge joint mounts **1036, 1038** by a U-shaped key **1039** that mounts to a corresponding slot in each respective rack **1020, 1022**. The mounting cups or hinge joint mounts **1036, 1038** connect to the lower surface of the footboard **1000**, and control the vertical and lateral travel of the heads **1032, 1034**. The hinge joint mounts **1036, 1038** permit the heads **1032, 1034** to pivot and slide laterally as well as travel vertically within the hinge joint mounts **1036, 1038**. The vertical and lateral travel of the heads **1032, 1034** provide a range and degree of freedom for the racks **1020, 1022** to move during driving and turning of the apparatus. The mounting cups or hinge joint mounts **1036, 1038** can include a cushioning material such as a rubber sock to minimize metal-to-metal contact between the heads **1032, 1034** and the interiors of the mounting cups or hinge joint mounts **1036, 1038**. The helical compression springs **1024, 1026** each mount circumferentially around a portion of the respective rack **1020, 1022** extending between the footboard **1000** and the casings **1012, 1014** such that an end of each spring **1024, 1026** is adjacent to the lower surface of the footboard **1000** or respective hinge joint mount **1036, 1038**, and an opposing end of the springs **1024, 1026** is adjacent to the upper surface of the respective casing **1012, 1014**. Both helical compression springs **1024, 1026** are preloaded. The springs **1024, 1026** can

then be further loaded by applying a downward force to the footboard **1000**, such as a user standing on the upper surface of the footboard **1000**.

Note that the geartrains described and shown are by example only, and other configurations and devices can be utilized in accordance with various embodiments of the invention. Examples of a geartrain can include, but is not limited, chain type-drives, band type-drives, hydraulic-type drives, or other gear drives that translate a downward force into a rotational force.

A steering support **1040** is adapted to transfer a directional force from the footboard **1000** to at least one of the transmission assemblies **1008, 1010**. The steering support **1040** is V-shaped with a central hinge hole **1042**, and end hinge holes **1044, 1046** adjacent to the ends of the support **1040**. The steering support **1040** mounts to the lower surface of footboard **1000** via a support mounting frame or support linkage **1048**. Respective transmission linkages **1050, 1052** mount to opposing ends of the steering support **1040**. The central hinge hole **1042** is sized to receive a hinge **1054** adapted to connect the steering support **1040** to the support mounting frame or support linkage **1048**, and each of the end hinge holes **1044, 1046** are sized to receive respective hinges **1056, 1058** connecting the ends of the steering support **1040** to the respective transmission linkages **1050, 1052**. Note that in this embodiment, the hinges **1054, 1056, 1058** shown are bolt shaped.

Each geartrain **1008, 1010** also includes a respective steering linkage **1060, 1062**. Each of the steering linkages **1060, 1062** connect with a respective transmission linkage **1050, 1052** and the steering support **1040**. The steering linkages **1060, 1062** include a vertical hinge hole **1064, 1066** and a horizontal hinge hole **1068, 1070**. Respective

hinges **1056, 1058** connect through the horizontal hinge holes **1068, 1070** to connect the transmission linkages **1050, 1052** and the steering support **1040** to the steering linkages **1060, 1062**. Other hinges **1072, 1074** connect through the vertical hinge holes **1064, 1066** to connect the steering linkages **1060, 1062** to a respective geartrain **1008, 1010**.

The steering support **1040**, transmission linkages **1050, 1052**, and steering linkages **1060, 1062** are shown by way of example only, and other configurations or devices can be used in accordance with various embodiments of the invention.

The support linkage **1048** and corresponding hinge **1054** permit the steering support **1040** to pivot about the hinge **1054** along the longitudinal axis **1004** of the footboard **1000**. Likewise, the transmission linkages **1050, 1052,** corresponding hinges **1056, 1058**, steering linkages **1060, 1062**, and corresponding hinges **1072, 1074** permit the transmission assemblies **1008, 1010** to pivot along a vertical and horizontal axis with respect to the steering support **1040**.

A set of adjustment bolts **1076, 1078** mount to each respective steering linkage **1060, 1062**, and provide control adjustments for each steering linkage **1060, 1062**. Each set of adjustment bolts **1076, 1078** includes a pair of bolts positioned parallel to and on opposing sides of the hinges **1056, 1058**, and through a set of stops **1080, 1082** mounted to the steering linkages **1060, 1062**. The sets of adjustment bolts **1076, 1078** permit selective control of the range of pivoting motion of the transmission assemblies **1008, 1010** with respect to the steering support **1040**. When greater turning control of the apparatus is desired, either or both sets of adjustment bolts **1076, 1078** can be loosened. Loosening either or both sets of adjustment bolts **1076, 1078** provides a greater range of movement or freedom for the respective hinges **1056, 1058** to move with respect to the

transmission assemblies **1008, 1010**. Likewise, when less turning control of the apparatus is desired, either or both sets of adjustment bolts **1076, 1078** can be tightened. Tightening either or both sets of adjustment bolts **1076, 1078** provides a lesser range of movement or freedom for the respective hinges **1056, 1058** to move with respect to the transmission assemblies **1008, 1010**.

An example of a steering linkage is shown in greater detail in Detail "1" of FIG. 2. As shown, a steering linkage **1062** includes a horizontally positioned hinge **1058** that connects to the steering support **1040**, and a vertically positioned hinge **1066** that connects to the casing **1014**. A stop **1082** on a lateral side of the steering linkage **1062** provides a bolt hole for receiving an adjustment bolt **1078**.

Referring back to FIG. 1 and 2 for the embodiment shown, a cushioned stop **1084, 1086** is positioned between each set of adjustment bolts **1076, 1078** and the exterior surface of each respective casing **1012, 1014**. The cushioned stops **1084, 1086** provide a contact surface for the sets of adjustment bolts **1076, 1078** as each transmission assembly **1008, 1010** pivots with respect to the steering support **1040**, thus providing improved and smoother steering control for the apparatus.

Also shown in this embodiment, a brake **1088** mounts to the lower portion of the rear casing **1014**. The brake **1088** shown is a relatively flat strip **1090** mounted to and extending from the lower portion of the rear casing **1014**. At the extended end of the flat strip **1090**, a rubber brake pad **1092** mounts to the lower portion of the flat strip **1090** adjacent to the ground. When a user desires to apply the brake **1088**, a downward force is applied to the rear portion of the platform **1000** adjacent to the trailing edge **1006**. The brake pad **1092** contacts the ground and creates a frictional resistance against the ground,

thus slowing the forward velocity of the apparatus. A brake can also mount to either or both geartrains **1008, 1010** or to a set of wheels **1028, 1030**. Those skilled in the art will recognize the type of brake that can be utilized in accordance with the invention.

FIG. 3 illustrates a perspective view of a set of gears for the front transmission assembly of the apparatus shown in FIG. 1. FIG. 3 shows the rack **1020** engaged with rack gear **1100**. The rack gear **1100** mounts to a shaft **1102**. A second gear **1104** mounts to the shaft **1102** with a first one-way clutch or first overrunning clutch **1106**. The first overrunning clutch **1106** engages the shaft **1102** when the rack **1020** moves in a downward direction. When the rack **1020** moves in an upward direction, the shaft **1102** rotates freely without engaging the second gear **1104**. A third gear **1108** mounts to a corresponding axle **1112** with the set of wheels **1028**. The set of wheels **1028** mounts to the axle **1112** by way of a second one-way clutch or overrunning clutch **1110** in each wheel. Note that the shaft **1102** and axle **1112** are supported by the casing **1012**. The set of wheels **1028** mounts to the axle **1112**, with one wheel positioned at each end of the axle **1112**. Conventional bearings for rotation of the shaft **1102**, axle **1112**, and set of wheels **1028** are used. The third gear **1108** engages the second gear **1104** such that the axle **1112** drives the set of wheels **1028** when the axle **1112** rotates faster than the wheels **1028**. Thus, when the apparatus moves in a forward direction, the set of wheels rotates in a clockwise direction. When the rotational speed of axle **1112** is slower than that of the set of wheels **1028**, the second one-way clutch or overrunning clutch **1110** in each wheel permits the wheels to rotate faster than the axle **1112**, also known as a "freewheeling condition." When the apparatus attempts to move in a rearward or backward direction,

both the front rack **1020** and rear rack **1022** move upward at the same time, preventing the apparatus from moving in a rearward or backward direction.

In the embodiment shown, the total number of shafts can be greater or fewer. In FIG 1, the front transmission assembly **1008** has two shafts **1102, 1112**, while the rear transmission assembly **1010** has three shafts (shown in FIG. 4 as **1202, 1210** and **1216**). Those skilled in the art will recognize that other configurations of gears, shafts, one-way or overrunning clutches, or other devices can be used in accordance with the invention.

FIG. 4 illustrates a perspective view of a set of gears for the rear transmission assembly of the apparatus shown in FIG. 1. FIG. 4 shows the rack **1022** engaged with rack gear **1200**. The rack gear **1200** mounts to a shaft **1202**. A second gear **1204** mounts to the shaft **1202**. The second gear **1204** mounts the shaft **1202** with a first one-way clutch or first overrunning clutch **1206**. The first overrunning clutch **1206** is set in a similar driving direction as the rack gear **1200** so that downward movements of the rack **1022** rotate the shaft **1202** in a clockwise direction. A third gear **1208** mounts to an intermediate shaft **1210**. The third gear **1208** engages the second gear **1204,** and receives force from the second gear **1204**. In turn, the third gear **1208** transfers the force to the intermediate shaft **1210**. A fourth gear **1212** mounts to the intermediate shaft **1210**, and engages a fifth gear **1214** mounted to an axle **1216**. The fourth gear **1212** engages the fifth gear **1214**, and transfers force from the intermediate shaft **1210** to the fifth gear **1214**. In turn, the fifth gear **1214** transfers force from the fourth gear **1212** to the axle **1216**. A set of wheels **1030** mounts to the axle **1216** via a second one-way or overrunning clutch **1218** in each wheel. Note that the shafts **1202, 1210** and axle **1216** are supported by the casing **1014**. The set of wheels **1030** mounts to the axle **1216**, with

one wheel positioned at each end of the axle **1216**. Conventional bearings for rotation of the shafts **1202, 1210**, axle **1216**, and set of wheels **1030** are used.

When the axle **1216** rotates faster than the set of wheels **1030**, the downward movement of the rack **1022** drives the apparatus forward. When the rack **1022** moves in an upward direction, the first one-way or overrunning clutch **1206** permits the shaft **1202** to rotate freely without engaging the second gear **1204**. Those skilled in the art will recognize that other configurations of gears, shafts, one-way or overrunning clutches, or other devices can be used in accordance with the invention.

As previously described above, each of the springs **1024, 1026** has been previously compressed when positioned between the footboard **1000** and the respective transmission assemblies **1008, 1010**. When a user stands on the footboard **1000**, a downward force on the footboard **1000** is generated. To initiate forward movement and to increase the forward velocity of the apparatus shown, the user applies alternate and repetitive downward forces on the front portion and rear portion of the footboard **1000**. The user can generate increased downward force on either the front or rear portion of the footboard **1000** by adjusting his or her body weight over the corresponding portion of the footboard **1000**. The downward forces generated by the shifting of the user's body weight over the footboard **1000** further compress both helical compression springs **1024, 1026**. The springs **1024, 1026** store a portion of the downward forces as compression energy for a subsequent return or upward force on the footboard **1000**. The downward forces also drive the respective racks **1020, 1022** towards the corresponding series of gears and transmission assemblies **1008, 1010**. As described previously, the transmission assemblies **1008, 1010** translate the downward forces to respective moments upon each

axle **1112, 1216**, thus rotating the sets of wheels **1028, 1030** to move the apparatus in a forward direction. The stored compression energy of the springs **1024, 1026** combined with the user's shifting body weight to an opposing foot on the platform **1000** causes the racks **1020, 1022** to move in an upward or "return" direction, away from the series of gears and transmission assemblies. Thus, repetitively applying a downward force to the front portion of the footboard **1000** and alternately applying a downward force to the rear portion of the footboard **1000** drives the apparatus in a forward direction with increasing velocity.

For directional steering of the apparatus, such as making a turn, the footboard **1000** tilts in either lateral direction. While standing on the footboard **1000**, a user initiates a turn by shifting his or her body weight in a lateral direction depending on the desired direction of the turn. As the user shifts his or her body weight, the footboard **1000** tilts in a desired lateral direction. By shifting his or her body weight in a lateral direction, the user generates a lateral force on the footboard **1000**. The steering support **1040** transfers the lateral force from the footboard **1000** to one or both of the transmission assemblies **1008, 1010**. The hinge **1054** at the support linkage **1048** permits the steering support **1040** to pivot in a forward and rearward direction along a longitudinal axis of the footboard **1000**. Respective transmission linkages **1050, 1052** mount to opposing ends of the steering support **1040** via the steering linkages **1060, 1062**. Respective hinges **1056, 1058** connect through the horizontal hinge holes **1068, 1070** to connect the transmission linkages **1050, 1052** of the steering support **1040** to the steering linkages **1060, 1062**. Other hinges **1072, 1074** connect through the vertical hinge holes **1064, 1066** to connect the steering linkages **1060, 1062** to the respective geartrain **1008, 1010**. The transmission

linkages **1050, 1052,** corresponding hinges **1056, 1058**, steering linkages **1060, 1062**, and corresponding hinges **1072, 1074** permit the transmission assemblies **1008, 1010** to pivot along a vertical and horizontal axis with respect to the steering support **1040**. Cooperation between the steering support **1040**, transmission linkages **1050, 1052**, and steering linkages **1060, 1062**, and hinge joints **1016, 1018** permit a user to directionally steer the apparatus.

Greater or lesser turning control of the apparatus can be attained by tightening or loosening the adjustment bolts **1076, 1078** to permit greater or lesser range or freedom of pivoting movement of the transmission assemblies **1008, 1010** with respect to the steering support **1040**.

FIGs. 5A and 5B illustrate the operation of a steering support for the apparatus shown in FIG. 1. FIG. 5A is a bottom schematic view of the apparatus shown in FIG. 1, with the wheels oriented for moving the apparatus in a forward direction. FIG. 5B is another bottom view of the apparatus shown in FIG. 1, with the wheels oriented for turning the direction of the apparatus. Note that the illustrations shown are schematic views illustrating operation of the apparatus shown in FIG. 1. As shown in FIG. 14A, the steering support **1040** is in a substantially straight orientation with respect to the front transmission assembly **1008** and rear transmission assembly **1010**. The set of wheels **1028** for the front transmission assembly **1008** is in a similar orientation as the set of wheels **1030** for the rear transmission assembly **1010**. In the orientation shown, the apparatus can travel in a relatively straight direction, such as a substantially forward direction **1400** direction.

When the user initiates a turn with the apparatus, the user applies a lateral force **1404** to the footboard **1000** as shown in FIG. 5A. Then, as shown in FIG. 5B, the footboard **1000** transfers the lateral force to the steering support **1040**, and the steering support **1040** translates the lateral force to the transmission assemblies **1008, 1010**. The steering support **1040** is adapted to pivot about hinge **1054** at the support linkage **1048** so that the steering support **1040** can pivot in both lateral directions **1406, 1408**. Note that in response to other forces on the footboard **1000**, the steering support **1040** can also pivot about the hinge **1054** at the support linkage **1048** in the forward **1400** and/or rearward directions **1402**. In this example, a front portion **1410** of the steering support **1040** pivots in a lateral direction **1406** counter to the lateral direction **1408** of the pivot of the rear portion **1412** of the steering support **1040**. Respective transmission linkages **1050, 1052** and hinges **1056, 1058** mounted at opposing ends of the steering support **1040** permit the front transmission assembly **1008** and set of wheels **1028** to pivot in a lateral direction counter to the lateral direction of the pivot of the rear transmission assembly **1010** and set of wheels **1030**. Therefore, the front set of wheels **1028** and rear set of wheels **1030** turn in opposing directions to provide improved directional steering control of the apparatus as shown.

In other embodiments of the invention, greater or fewer numbers of wheels can be used. For example, a two-wheeled platform could operate in a similar manner as described above, with at least one wheel capable of pivoting to provide directional steering control.

FIG. 6 is a side view of a second embodiment of an apparatus in accordance with the invention. The apparatus **2000** shown in this embodiment is similar to the apparatus shown in FIGs. 1-5, except the apparatus **2000** shown is adapted for relatively greater drive distance and downward forces upon the footboard **2002**, such as the body weight of an adult standing on the footboard **2002**. Racks **2004, 2006**, springs **2008, 2010**, and steering support **2012** are also adapted to account for the relatively greater downward forces upon the footboard **2002**. For example, racks **2004, 2006** are relatively longer than the racks shown in FIG. 1. Accordingly, springs **2008, 2010** have an increased length, and steering support **2012** is relatively longer. Furthermore, a greater range of movement of the racks **2004, 2006** along the longitudinal axis of the apparatus **2000** may be needed to account for the longer length of the racks **2004, 2006**, therefore, the rack cups **2014, 2016** are adapted to slide back and forth with respect to the respective hinge joint mount **2018, 2020**. Geartrains or transmission assemblies **2014, 2016** are substantially similar to those shown as **1008, 1010** in FIG. 1. Note that the geartrains shown are by example only, and other configurations and devices can be utilized in accordance with various embodiments of the invention. A geartrain can include, but is not limited, chain type-drives, band type-drives, hydraulic-type drives, or other gear drives that translate a downward force into a rotational force. The embodiment shown operates in a similar manner as the embodiment shown and described in FIGs. 1-4, and 5A-5B. Those skilled in the art will recognize that other sizes and configurations of the various components can be used in accordance with the invention.

FIG. 7 is a perspective view of a third embodiment of an apparatus in accordance with the invention, with a portion of a footboard cutaway to show the underlying geartrain and support. The apparatus includes a footboard **3000** adapted to support a user on an upper surface. The footboard **3000** shown is similar to a footboard of a conventional skateboard. Typically, the footboard **3000** is positioned in a substantially horizontal orientation. In this example, the footboard **3000** is shown with a leading edge **3002** that arcs slightly downward from a horizontal axis **3004**, and a trailing edge **3006** that arcs slightly upward from the horizontal axis **3004**. The configurations of the leading edge **3002** and trailing edge **3006** assist a user with directional control and/or braking of the apparatus. Other apparatuses can have footboards with other configurations in accordance with the invention.

The apparatus also includes at least two geartrains or transmission assemblies **3008, 3010** adapted to translate a downward force from the footboard **3000** to a rotational force. Each of the transmission assemblies **3008, 3010** includes a respective casing **3012, 3014** hinge joint **3016, 3018**, rack **3020, 3022**, helical compression spring **3024, 3026**, and a set of wheels **3028, 3030**. The casings **3012, 3014** each house a series of gears (similar to those shown and described in FIGs. 3 and 4) that translate the vertical movement of the racks **3020, 3022** to respective rotations of the sets of wheels **3028, 3030**. The hinge joints **3016, 3018** are each adapted to transfer force between the footboard **3000** and the respective racks **3020, 3022** and further adapted to mount the transmission assemblies **3008, 3010** to the lower surface of the footboard **3000**. The racks **3020, 3022** each extend vertically upward from the respective casings **3012, 3014**

towards the lower surface of the footboard **3000**, and each rack **3020, 3022** contacts at least one gear inside the respective casing **3012, 3014**.

Note that the geartrains shown are by example only, and other configurations and devices for propelling a platform can be utilized in accordance with various embodiments of the invention. Examples of a geartrain can include, but are not limited to, chain type-drives, band type-drives, hydraulic-type drives, or other gear drives that translate a downward force into a rotational force.

FIG. 8 is a side view of the embodiment shown in FIG. 7. As shown in FIG. 8, a respective hinge joint mount **3032, 3034** receives each hinge joint **3016, 3018**. The hinge joint mounts **3032, 3034** each connect to the lower surface of the footboard **3000** to control the movement of the hinge joint **3016, 3018**. The helical compression springs **3024, 3026** each mount circumferentially around a portion of the respective rack **3020, 3022** extending between the footboard **3000** and the casings **3012, 3014** such that an end of each spring **3024, 3026** is adjacent to the lower surface of the footboard **3000** or hinge joint mount **3032, 3034**, and an opposing end of the springs **3024, 3026** is adjacent to the upper surface of the casings **3012, 3014**. Both helical compression springs **3024, 3026** are preloaded by adjusting the distance between the footboard **3000** and the casings **3012, 3014**. The springs **3024, 3026** can then be further loaded by applying a downward force to the footboard **3000**, such as a user standing on the upper surface of the footboard **3000**.

Referring to FIG. 7, a steering support **3036** is adapted to transfer a directional force from the footboard **3000** to at least one of the transmission assemblies **3008, 3010**. The steering support **3036** shown is similar to the steering support shown in FIG. 1, however, the steering support **3036** shown includes a centrally located hinge **3038** and no

hinges at the ends of the steering support **3036**. Rather, the steering support **3036** is V-shaped with a central hinge hole **3040**, and includes end hinge mounts **3042, 3044** adjacent to the ends of the support **3036**. The steering support **3036** mounts to the lower surface of footboard **3000** via a support linkage **3046**. The support linkage **3046** can include a rubber or cushioning pad between the linkage **3046** and the footboard **3000** to provide additional flexibility. The central hinge hole **3040** is sized to receive the hinge **3038** adapted to connect the steering support **3036** to the support linkage **3046**, and each of the end hinge mounts **3042, 3044** connect the ends of the steering support **3036** to the respective transmission assemblies **3008, 3010**. The end hinge mounts **3042, 3044** can each include a rubber or cushioning pads between the mounts **3042, 3044** and the respective transmission assemblies **3008, 3010** to provide additional flexibility.

As shown in FIG. 8, the support linkage **3046** and corresponding hinge **3038** permit the footboard **3000** to pivot with respect to the steering support **13036**. Likewise, the support linkage **3046** and corresponding hinge **3038** also permit the footboard **3000** to pivot with respect to the transmission assemblies **3008, 3010**. For example, when a downward force **3100** is applied to a front portion **3102** of the footboard **3000**, the front portion **3102** of the footboard **3000** pivots downward while the rear portion **3104** of the footboard **3000** pivots about the hinge **3038** in an opposing and upward direction **3106**. Likewise, if a downward force is applied to the rear portion **3104** of the footboard **3000**, then the front portion **3102** of the footboard **3000** pivots about the hinge **3038** in an opposing and upward direction **3106**. An optional brake (not shown) can be mounted to either of the geartrains **3008, 3010**, casings **3012, 3014**, or set of wheels **3028, 3030**. Those skilled in the art will recognize the type of brake that can be utilized in accordance

with the invention. The embodiment shown in FIGs. 7 and 8 operates similarly to the embodiments shown in FIGs. 1-6.

FIG. 9 is a side view of a fourth embodiment of an apparatus in accordance with the invention. The footboard **4000** is adapted to support a user on an upper surface. The footboard **4000** shown is similar to a footboard of a conventional skateboard. Typically, the footboard **4000** is positioned in a substantially horizontal orientation. In this example, the footboard **4000** is shown with a leading edge **4002** that arcs slightly downward from a horizontal axis **4004**, and a trailing edge **4006** that arcs slightly upward from the horizontal axis **4004**. The configurations of the leading edge **4002** and trailing edge **4004** assist a user with directional control and/or braking of the apparatus. Other apparatuses can have footboards with other configurations in accordance with the invention.

The apparatus shown also includes two geartrains or transmission assemblies **4008, 4010** adapted to translate a downward force from the footboard **4000** to a rotational force. Greater or fewer numbers of geartrains or transmission assemblies can be used in accordance with the invention. Each of the transmission assemblies **4008, 4010** includes a respective casing **4012, 4014**, hinge joint **4016, 4018**, drive arm **4020, 4022**, a torque spring **4024, 4026**, and a set of wheels **4028, 4030**. The casings **4012, 4014** each house a series of gears (shown in FIGs. 10 and 11) that translate rotation of the transmission assemblies **4008, 4010** to respective rotations of the sets of wheels **4028, 4030**. The hinge joints **4016, 4018** are each adapted to transfer force between the footboard **4000** and the respective drive arms **4020, 4022**, and are further adapted to mount the transmission assemblies **4008, 4010** to the lower surface of the footboard **4000**. The

drive arms **4020, 4022** each extend vertically upward from the respective casings **4012, 4014** towards the lower surface of the footboard **4000**, and each drive arm **4020, 4022** rotates at least one shaft inside the respective casing **4012, 4014**. Note that in the embodiment shown, the drive arms **4020, 4022** extend at a slight angle from the casings **4012, 4014** towards the lower surface of the footboard **4000**. A respective arm mount frame **4032, 4034** receives one of the hinge joints **4016, 4018**. The arm mount frames **4032, 4034** each connect to the lower surface of the footboard **4000** to control the movement of the hinge joints **4016, 4018**, and to further control the directional steering of the apparatus. A compressible rubber material **4036, 4038** mounts within the arm mount frames **4032, 4034** and adjacent to each drive arm **4020, 4022**. The torque springs **4024, 4026** each mount within the casings **4012, 4014** and work in conjunction with the series of gears shown in FIGs. 10 and 11. Both torque springs **4024, 4026** are preloaded by adjusting an initial starting angle of each spring. The torque springs **4024, 4026** can then be further loaded by applying a downward force to the footboard **4000**, such as a user standing on the upper surface of the footboard **4000** and applying sufficient downward force to rotate the geartrains or transmission assemblies **4008, 4010**.

Note that the geartrains shown are by example only, and other configurations and devices for propelling a platform can be utilized in accordance with various embodiments of the invention. Examples of a geartrain can include, but are not limited to, chain type-drives, band type-drives, hydraulic-type drives, or other gear drives that translate a downward force into a rotational force.

FIG. 10 is a front detail view A-A of the apparatus shown in FIG. 9. This drawing illustrates the front transmission assembly **4008** in greater detail. FIG. 10 shows

the drive arm **4020** and a series of gears. The drive arm **4020** mounts to a first shaft **4100** with a first one-way clutch or first overrunning clutch **4102**. In the embodiment shown, the drive arm **4020** includes a pair of arms **4104, 4106** that engage the first shaft **4100** at intermediate portions of the shaft **4100**. A first gear **4108** also mounts to the first shaft **4100** near the central portion of the shaft **4100**. The first overrunning clutch **4102** is set in a similar driving direction as the first gear **4108** so that torque force of the drive arm **4020** rotates the shaft **4100** in a counterclockwise direction. Likewise, the first overrunning clutch **4102** permits the first gear **4108** to rotate in a counterclockwise direction when the transmission assembly **4008** rotates around the shaft **4100**.

Torque spring **4024** also mounts to the shaft **4100** with a compressible material **4109** positioned between the torque spring **4024** and the shaft **4100**. The torque spring and compressible material **4109** are adapted to provide a "return" force on the transmission assembly **4008**. The spring **4024** shown includes a helical portion that is circumferentially wound about an intermediate portion of the shaft **4100**. One end of the torque spring **4024** pushes against the drive arm **4020**, while an opposing end of the torque spring **4024** pushes against an interior wall of the transmission assembly **4008**. Other configurations or combinations of springs or other devices can be adapted to provide a return force on the transmission assembly **4008** in accordance with the invention.

A second gear **4110** mounts to a second shaft **4112**. The second gear **4110** contacts the first gear **4108**, and receives force transferred from the drive shaft **4100** to the first gear **4108**. When the first gear **4108** rotates in a counterclockwise direction, the second gear rotates in an opposing, clockwise direction. A third gear **4114** also mounts

to the second shaft **4112**, and rotates in the same direction as the second gear **4110**. Thus, when the second gear **4110** rotates, the force transferred from the first gear **4108** is transferred to the second gear **4110**, the second shaft **4112**, and then to the third gear **4114**. When the second gear **4110** rotates in a clockwise direction, the second shaft **4112** and third gear **4114** also rotate in a clockwise direction.

A fourth gear **4116** mounts to a corresponding axle **4118**. The set of wheels **4028** mounts to the axle **4118** with a second one-way clutch or overrunning clutch **4120**. The fourth gear **4116** engages the third gear **4114** such that the fourth gear **4116** rotates in an opposing and counterclockwise direction transmission assembly **4008** pivots around shaft **4100** Therefore, when a downward force is applied to the footboard **4000**, the transmission assembly **4008** pivots around the shaft **4100** toward the front portion of the footboard **4000**. The transmission assembly **4008** translates the pivoting motion into a rotational force on the set of wheels **4028** to drive the apparatus in a forward direction. Those skilled in the art will recognize that other configurations of gears, overrunning clutches, shafts or axles, and other devices can be used in accordance with the invention.

Note that the shafts **4100, 4112** and axle **4118** are supported by the casing **4012**. The set of wheels **4028** mounts to opposing ends of the axle **4118**. Conventional bearings for rotation of the shafts **4100**, **4112**, axle **4118**, and set of wheels **4028** are used.

If the rotational speed of axle **4118** is slower than that of the set of wheels **4028** in a counterclockwise direction when the apparatus is moving in a forward direction, the overrunning clutches **4102, 4120** operate in a freewheeling condition. The freewheeling condition of the overrunning clutches **4102, 4120** permit the apparatus to move forward.

FIG. 11 is a rear detail view B-B of the apparatus shown in FIG. 9. This drawing illustrates the rear transmission assembly **4010** in greater detail. FIG. 11 shows the drive arm **4022** and a series of gears. Similar to the drive arm **4020** of the front transmission assembly shown in FIG. 10, the drive arm **4022** mounts to a first shaft **4200** with a first one-way clutch or first overrunning clutch **4202**. In the embodiment shown, the drive arm **4022** includes a pair of arms **4204, 4206** that engage the first shaft **4200** at intermediate portions of the shaft **4200**. A first gear **4208** also mounts to the first shaft **4200** near the central portion of the shaft **4200**. The first overrunning clutch **4202** is set in a similar driving direction as the first gear **4208** so that the pivot of the transmission assembly **4010** around shaft **4200** rotates the shaft **4200** in a clockwise direction, thus rotating the first gear **4208** in a clockwise direction.

Torque spring **4026** also mounts to the shaft **4200** with a compressible material **4209** positioned between the torque spring **4026** and the shaft **4200**. The torque spring **4026** and compressible material **4209** are adapted to provide a "return" force on the transmission assembly **4010**. Similar to the spring **4024** shown in FIG. 10, the spring **4026** shown includes a helical portion that is circumferentially wound about an intermediate portion of the shaft **4200**. One end of the torque spring **4024** pushes against the drive arm **4020**, while an opposing end of the torque spring **4024** pushes against an interior wall of the transmission assembly **4010**. Other configurations or combinations of springs or other devices can be adapted to provide a return force on the transmission assembly **4010** in accordance with the invention.

A second gear **4210** mounts to a second shaft **4212**. The second gear **4210** contacts the first gear **4208**, and receives force transferred from the drive shaft **4200** to

the first gear **4208**. When the first gear **4208** rotates in a clockwise direction, the second gear **4210** rotates in an opposing, counterclockwise direction. A third gear **4214** also mounts to the second shaft **4212**, and rotates in the same direction as the second gear **4210**. Thus, when the second gear **4210** rotates, the force transferred from the first gear **4208** is transferred to the second gear **4210**, the second shaft **4212**, and then to the third gear **4214**. When the second gear **4210** rotates in a counterclockwise direction, the second shaft **4212** and third gear **4214** also rotate in a counterclockwise direction.

A fourth gear **4216** mounts to a third shaft **4218**. The fourth gear **4216** contacts the third gear **4214**, and receives force transferred from the drive shaft **4200**, the first gear **4208**, the second gear **4210**, and the third gear **4214**. When the third gear **4214** rotates in a counterclockwise direction, the fourth gear **4216** rotates in an opposing, clockwise direction. A fifth gear **4220** also mounts to the third shaft **4218**, and rotates in the same direction as the fourth gear **4216**. Thus, when the second gear **4210** rotates, the force transferred from the first gear **4208** is transferred to the second gear **4210**, to the second shaft **4212** and third gear **4214**, and then to the fourth gear **4216** and fifth gear **4220**. When the fourth gear **4216** rotates in a clockwise direction, the third shaft **4218** and fifth gear **4220** also rotate in a clockwise direction.

A sixth gear **4222** mounts to a corresponding axle **4224** with the set of wheels **4030**. The axle **4224** supports the set of wheels **4030** that mount to the axle **4224** via a second one-way clutch or overrunning clutch **4226.** The fifth gear **4220** engages the sixth gear **4222** such that the fifth gear **4220** rotates in an opposing and counterclockwise direction when the drive arm **4022** moves in a downward direction. The sixth gear **4222** rotates in a single direction when the drive arm **4022** moves in either an upward or

downward direction. Thus, when the fifth gear **4220** rotates in a counterclockwise direction, the axle **4226** and sixth gear **4222** rotate in an opposing, clockwise direction.

Therefore, when a downward force is applied to the footboard **4000**, the transmission assembly **4010** pivots around the shaft **4200** toward the rear portion of the footboard **4000**. The transmission assembly **4010** translates the pivoting motion into a rotational force on the set of wheels **4030** to drive the apparatus in a forward direction. Those skilled in the art will recognize that other configurations of gears, overrunning clutches, shafts or axles, and other devices can be used in accordance with the invention.

Note that the shafts **4200, 4212, 4218,** and axle **4224** are supported by the casing **4014**. The set of wheels **4030** mounts to opposing ends of the axle **4224**. Conventional bearings for rotation of the shafts **4200**, **4212**, **4218**, axle, **4224**, and set of wheels **4030** are used.

If the rotational speed of axle **4224** is slower than that of the set of wheels **4030** in a counterclockwise direction when the apparatus is moving in a forward direction, the overrunning clutches **4202, 4226** operate in a freewheeling condition. The freewheeling condition of the overrunning clutches **4202, 4226** permits the apparatus to move forward.

FIG. 12 is a side view of the apparatus shown in FIG. 9, with a pivoting range of motion shown for each transmission assembly. When in use, the apparatus shown here adapts to the downward force generated by the user on the footboard **4000**, such as the body weight of the user, by pivoting the transmission assemblies **4008, 4010** upward and outward in response to the downward force. For example, when a user stands on the footboard **4000**, each of the transmission assemblies **4008, 4010** can respectively pivot upward and outward with respect to the first shafts **4100, 4200** as shown. The range of

the pivot angles **4300, 4302** for each transmission assembly **4008, 4010** increases as the downward force increases. In the embodiment shown, a range of pivot angles **4300, 4302** between approximately 0 to 40 degrees for both the front transmission assembly **4008** and rear transmission assembly **4010** can be achieved.

To initiate forward movement and to increase the forward velocity of the apparatus, a user stands on the footboard **4000** and applies alternate and repetitive downward forces on the front portion and rear portion of the footboard **4000**. As the footboard **4000** moves downward, each of the drive arms **4020, 4022** transfer the alternating downward forces to the respective transmission assemblies **4008, 4010**. Each of the torque springs **4024, 4026** then provide repetitive and alternate upward "return" forces to the footboard **4000**.

For directional steering of the apparatus, such as making a turn, the footboard **4000** tilts in either lateral direction. While standing on the footboard **4000**, a user initiates a turn by shifting his or her body weight in a lateral direction depending on the desired direction of the turn. As the user shifts his or her body weight, the footboard **4000** tilts in a desired lateral direction. By shifting his or her body weight in a lateral direction, the user generates a lateral force on the footboard **4000**. The hinge joints **4016, 4018** permit the footboard **4000** to pivot laterally, such as either to the left or right, as the compressible material **4109**, **4209** deforms with the force applied by the user. The pivoting of the footboard **4000** to either side changes the direction of the arm mount frames **4032, 4034**, and automatically turns the drive arms **4020**, **4022** in the same direction. The pivot or direction of turn by the drive arms **4020, 4022** determines the direction of each respective transmission assembly **4008, 4010**. Thus, when a lateral

force is applied to the footboard, the transmission assemblies **4008, 4010** pivot in opposing lateral directions to each other, turning the sets of wheels **4028, 4030** in opposing directions and facilitating turning of the apparatus.

FIGs. 13A and 13B illustrate the operation of the apparatus shown in FIGs. 9-12. FIG. 13A is a bottom schematic view of the apparatus shown in FIG. 9-12, with the wheels oriented for moving the apparatus in a forward direction. FIG. 13B is another bottom view of the apparatus shown in FIGs. 9-12, with the wheels oriented for turning the direction of the apparatus. As shown in FIG. 13A, the apparatus is positioned in a substantially straight orientation with the front arm mount frame **4032** and rear arm mount frame **4034**similarly aligned. Note that the set of wheels **4028** for the front arm mount frame **4032** is in a similar orientation as the set of wheels **4030** for the rear arm mount frame **4034**. In the orientation shown, the apparatus can travel in a relatively straight direction, such as a forward direction **4400**.

When a user initiates a turn with the apparatus, the user applies a downward, lateral force **4404** to the footboard **4000**. As shown in FIG. 13B, the footboard **4000** transfers the downward, lateral force **4402** to the hinge joints **4016, 4018** and the arm mount frames **4032, 4034**. The tilting of the platform **4000** causes the platform to rotate with respect to the hinge joints **4016, 4018**, thus changing the direction of arm mount frames **4032, 4034**. The change in direction of arm mount frames **4032, 4034** pivots the respective drive arms **4020, 4022** and the transmission assemblies **4008, 4010** in a corresponding direction.

FIG. 14 is a perspective view of a fifth embodiment of an apparatus in accordance with the invention. The apparatus shown is a scooter **5000** that is propelled by driving two pedals **5002, 5004** upward and downward. Each pedal **5002, 5004** is adapted to receive a portion of a user's body weight when a user's foot is placed on each pedal **5002, 5004**. Each pedal **5002, 5004** is also adapted to move between an initial position and a depressed position. The scooter **5000** also includes a geartrain or transmission assembly **5006** oriented towards the rear portion of the scooter **5000** that translates downward force on the pedals **5002, 5004** to a rotational force on a set of wheels **5008**. The scooter **5000** further includes a T-shaped steering handle **5010** which mounts to a front wheel **5012** and a lower frame **5014**. Note that the geartrain shown is by example only, and other configurations and devices for propelling a scooter can be utilized in accordance with various embodiments of the invention. A geartrain can include, but is not limited to, chain type-drives, band type-drives, hydraulic-type drives, or other gear drives that translate a downward force into a rotational force.

The embodiment shown is also called a "reverse" pedaling scooter. With conventional scooters and pedal-type devices, users operate the conventional devices by facing a drive arm shaft of a geartrain. Users operating the described embodiment experience a different type of pedaling motion than with conventional devices since the drive arm shaft of the geartrain or transmission assembly **5006** shown is positioned behind the user.

The scooter **5000** also includes attachment devices **5016a, 5016b**, in the front portion of the scooter **5000**, and attachment device **5016c** in the rear portion of the scooter **5000**. The attachment devices **5016a, 5016b, 5016c** are adapted to connect the

scooter **5000** to other scooters with corresponding attachment devices **5016a, 5016b, 5016c** or similar type devices to form a scooter train as shown in FIG. 22. Attachment device **5016a** is a L-shaped hook that mounts to the front portion of the lower frame **5014** or to a sleeve on the handle **5010** with an extended portion of the L-shaped hook facing downward. The L-shaped hook portion includes an adjustable nut **5017** at the end of the portion facing downward. Likewise attachment device **5016b** is a relatively smaller L-shaped hook that mounts to the front portion of the lower frame **5014** or to a sleeve on the handle **5010** with an extended portion of the hook facing downward. The L-shaped hook portion also includes an adjustable nut **5017** at the end of the portion facing downward. Corresponding attachment device **5016c** is an elongated loop that mounts to the rear portion of the lower frame **5014** and can receive the extended portion of attachment device **5016a** or **5016b**. Either of the attachment devices **5016a, 5016b** can be further secured to attachment device **5016c** by mounting the respective attachment devices **5016a, 5016b** to the corresponding attachment device **5016c**, and then mounting the adjustable nut **5017** to the extended end of attachment device **5016a, 5016b**. Adjusting the adjustable nut **5017** limits the insertion of the L-shaped hook portion of an attachment device **5016a, 5016b** into a corresponding attachment device **5016c**.

When a scooter with attachment device **5016b** connects to the rear portion of a scooter with corresponding attachment device **5016c**, the front wheel **5012** of the scooter is lifted from the ground and the front portion of the scooter **5000** is supported by the connection between attachment devices **5016b** and **5016c**. The front scooter will control the steering for both scooters, and both scooters can be propelled by use of the paddles. If a scooter with attachment device **5016a** connects to the rear portion of a scooter with

corresponding attachment device **5016c**, the front wheel **5012** of the scooter touches the ground. The rear scooter can partially control the steering for the connected scooters, while both scooters can be propelled by use of the paddles. In either configuration, multiple scooters with connection devices **5016a, 5016b, 5016c** can be connected together to form a "scooter train" as shown in FIG. 22. Other devices or methods to connect scooters together can be used in accordance with the invention.

FIGs. 15-17 illustrate a transmission assembly for the apparatus shown in FIG. 14. FIG. 15 is a side sectional view of a transmission assembly, FIG. 16 is an overhead sectional view of the transmission assembly shown in FIG. 15, and FIG. 17 is a cross sectional view of the transmission assembly shown in FIG. 15. The two pedals **5002, 5004** mount to a respective drive arm **5018, 5020** that also connect to the transmission assembly **5006**. The drive arms **5018, 5020** cooperate with the transmission assembly **5006** so that when one pedal **5002** moves in a downward direction, the other pedal **5004** moves in an opposing, upward direction. This type of action is also known as "drive pedal recovery" or "drive arm recovery." Devices that perform this type of action, such as the combination of shafts, gears, and clutches shown here, are known as "recovery action" devices. The drive arms **5018, 5020** each mount to a first shaft **5022** via a respective one-way or overrunning clutch **5024, 5026**. When drive arm **5018** is pressed down, a first return gear **5028** engages a second return gear **5030,** and second return gear **5030** further engages a third return gear **5032** mounted on a second shaft **5034**. Subsequent rotation of the third return gear **5032** rotates the second shaft **5034** in a counterclockwise direction. In turn, second shaft **5034** rotates fourth return gear **5036**, and fourth return gear **5036** engages and rotates fifth return gear **5038** in a clockwise

direction. Due to the staggered cross-sectional view of FIG. 17, the fourth return gear **5036** and fifth return gear **5038** are not shown engaging each other. Note also that the first return gear **5028** and third return gear **5032** have the same number of gear teeth, and likewise, the fourth return gear **5036** and fifth return gear **5038** have the same number of gear teeth. The number of gear teeth of the third return gear **5032** is less than that of the fourth return gear **5036** so that the first return gear **5028** and third return gear **5032** do not directly engage, while the fourth return gear **5036** and fifth return gear **5038** are directly engaged.

The starting position of drive arms **5018, 5020** can be manually adjusted by repositioning the respective second return gear **5030**. When the second return gear **5030** is pulled outward and away from first return gear **5028**, the drive arms **5018, 5020** can be vertically raised or lowered with respect to the second return gear **5030**. After adjustment of the drive arms **5018, 5020** to a desired starting position, second return gear **5030** is pushed back towards and engaged with the first return gear **5028**. In this manner, the vertical positions of the drive arms **5018, 5020** can be adjusted for the convenience, comfort, or fit of a user.

The drive arm or drive pedal recovery action in the transmission assembly **5006** provides a "return" force to each respective drive arm **5018, 5020** when the opposing drive arm **5018, 5020** moves to a depressed position. For example, when drive arm **5018** is initially positioned at a relatively higher starting position and the drive arm **5018** receives a downward force, the drive arm **5018** moves pedal **5002** from to a lower, depressed position. The drive arm or drive pedal recovery action moves the opposing drive arm **5020** from an initial lower, depressed position to a relatively higher position

where the corresponding pedal **5004** can receive a downward force from the user. The user forces drive arm **5020** and pedal **5004** downward, and the drive arm or drive pedal recovery action in the transmission assembly **5006** provides a "return" force to drive arm **5018** and pedal **5002** moves back to the higher starting position.

Downward forces applied to the pedals **5002, 5004** are transferred to the rear set of wheels **5008** by the transmission assembly **5006**. The transmission assembly **5006** includes a first drive gear **5040** mounted to the first shaft **5022**, a second drive gear **5042** mounted to a second shaft **5044**, a third drive gear **5046** mounted to the second shaft **5044**, and a fourth drive gear **5048** mounted to a rear axle **5050**.

Note that the shafts **5022, 5044**, and axle **5050** are supported by a casing **5052**. The set of wheels **5008** mounts to opposing ends of the axle **5050**. Conventional bearings for rotation of the shafts **5022**, **5044**, axle **5050**, and set of wheels **5008** are used.

Downward forces transferred from the pedals **5002, 5004** to the overrunning clutches **5024, 5026** are transmitted to the first drive gear **5040** via the first shaft **5022**. The first drive gear **5040** transfers the force to the second drive gear **5042**. The second drive gear **5042** transfers the force through the second shaft **5044** to the third drive gear **5046**. The third drive gear **5046** then transmits the force to the fourth drive gear **5048**, and the fourth drive gear **5048** transmits the force to the rear axle **5050**. The force on the rear axle **5050** causes the rear set of wheels **5008** mounted to the rear axle **5050** to turn accordingly. Other configurations of gears can be utilized for a transmission assembly in accordance with the invention.

A second one-way clutch or overrunning clutch **5054, 5056** in each wheel of the rear set of wheels **5008** permits the rear set of wheels **5008** to rotate faster than the rear

axle **5050**. This type of motion is similar to the freewheeling motion described with respect to the embodiments above.

An optional brake (not shown) can be mounted to the set of wheels **5008**, and a manual grip (not shown) to apply the brake can be connected to the handle **5010**. Those skilled in the art will recognize the type of brake and manual grip that can be utilized in accordance with the invention.

A user operates the scooter **5000** by repetitively and alternatively depressing each pedal **5002, 5004** in a downward direction. The downward forces on the pedals **5002, 5004** are translated by the transmission assembly **5006** into a rotational force on the set of wheels **5008**, propelling the scooter **5000** in a forward direction. Directional steering of the scooter can be achieved by turning the handle **5010** and front wheel **5012** in the desired direction of travel. When used in conjunction with other scooters with corresponding attachment devices, the scooter **5000** can be connected via the attachment devices **5016a, 5016b, 5016c** to form a scooter train shown in FIG. 22 that can be propelled and steered in a similar manner as described above.

FIG. 18 is a sixth embodiment of an apparatus in accordance with the invention. FIG. 18 shows a partial side view of the apparatus. FIG. 19 is an overhead cross-sectional view of a transmission assembly for the apparatus shown in FIG. 18. Note that the view shown in FIG. 19 is a staggered sectional view through multiple planes of the transmission assembly. The apparatus shown is a scooter **6000** that is propelled by driving two pedals **6002, 6004** upward and downward. Each pedal **6002, 6004** is adapted to receive a portion of a user's body weight when each of a user's feet are placed on a respective pedal **6002, 6004**. Each pedal **6002, 6004** is also adapted to move between an

initial position and a depressed position. The scooter **6000** also includes a geartrain or transmission assembly **6006** oriented towards the rear portion of the scooter **6000** that translates downward force on the pedals **6002, 6004** to a rotational force on a set of wheels **6008**. Note that the geartrain shown is by example only, and other configurations and devices can be utilized in accordance with various embodiments of the invention. A geartrain can include, but is not limited to, chain type-drives, band type-drives, hydraulic-type drives, or other gear drives that translate a downward force into a rotational force. The scooter **6000** includes a T-shaped steering handle **6010** which mounts to a front wheel **6012** and a lower frame **6014**.

Note that the apparatus shown is similar to and operates in a similar manner as the embodiment described in FIGs. 14-17. The differences are that there are two additional shafts in the transmission assembly **6006** of the embodiment shown, and the transmission assembly **6006** is mounted partially above the frame **6014**.

FIG. 20 is a perspective view of a seventh embodiment of an apparatus in accordance with the invention. In this embodiment, the apparatus is a scooter **7000** that is propelled by driving two pedals **7002, 7004** upward and downward. The pedals **7002, 7004** are adapted to receive a portion of a user's body weight when each of the user's feet are placed on a respective pedal **7002, 7004**. The pedals **7002, 7004** are adapted to move between an initial position and a depressed position. The scooter **7000** also includes a geartrain or transmission assembly **7006** oriented towards the rear portion of the scooter **7000** that translates downward force on the pedals **7002, 7004** to a rotational force on a set of wheels **7008**. Note that the geartrain shown is by example only, and other configurations and devices to propel a scooter can be utilized in accordance with various

embodiments of the invention. A geartrain can include, but is not limited to, chain type-drives, band type-drives, hydraulic-type drives, or other gear drives that translate a downward force into a rotational force. The scooter **7000** also includes attachment devices **7010a, 7010b** in the front portion of the scooter **7000**, and attachment device **7010c** in the rear portion of the scooter **7000**. The attachment devices **7010a, 7010b, 7010c** are similar to those shown and described above as **5016a, 5016b, 5016c** in FIG. 14, and can operate in conjunction with other scooters with corresponding attachment devices to form a scooter train as shown in FIG. 22.

Referring back to FIG. 20, the scooter **7000** includes a T-shaped steering handle **7012** which mounts to a front wheel **7014** and a lower frame **7016**. The two pedals **7002, 7004** both mount to the lower frame **7016** with a respective leaf spring **7018, 7020** for each pedal **7002, 7004**. One end of each leaf spring **7018, 7020** mounts to an upper surface of the lower frame **7016** and an opposing end of each leaf spring **7018, 7020** mounts to the lower surface of a respective pedal **7002, 7004**. A drive arm **7022, 7024** also mounts to the lower surface of each pedal **7002, 7004**. A respective drive arm guide **7026, 7028** mounted to the lower surface of each pedal **7002, 7004** limits the movement of the drive arms **7022, 7024** with respect to the pedals **7002, 7004**. An opposing end of each drive arm **7022, 7024** connects to the transmission assembly **7006**. An angled crankshaft **7030, 7032** also mounts to the lower surface of each pedal **7002, 7004**, and each mounts to the upper surface of the lower frame **7016**. The drive arms **7022, 7024**, crankshafts **7030, 7032**, and leaf springs **7018, 7020** cooperate with the transmission assembly **7006** so that when one pedal **7002** moves in an upward direction, the other pedal **7004** moves in an opposing, downward direction. The drive arms **7022, 7024** each

mount to a first shaft **7034** via a respective one-way or overrunning clutch **7036, 7038**. A spring **7040, 7042** mounts to each drive arm **7022, 7024** to provide an upward "return" force to the drive arm **7022, 7024** when the respective arm **7022, 7024** moves to a depressed position. The upward "return" force moves the drive arm **7022, 7024** to the initial position to receive another downward force. Note that in this embodiment, the springs **7040, 7042** act as "recovery action" devices. The set of wheels **7008** also includes a one-way or overrunning clutch (not shown) to permit the wheels to continue rotating or otherwise rotate faster than the rotation of the corresponding axle for the set of wheels **7008**.

An optional brake (not shown) can be mounted to the set of wheels **7008**, and a manual grip (not shown) to apply the brake can be connected to the handle **7012**. Those skilled in the art will recognize the type of brake and manual grip that can be utilized in accordance with the invention.

The transmission assembly **7006** includes a series of gears similar to those shown and previously described in FIG. 15-17. A casing **7044** protects the transmission assembly **7006** from exterior contact or interference from the user or exterior objects. The scooter **7000** shown in FIG. 20 operates in a similar manner as the apparatuses shown and described in FIGs. 14-17, and FIGs. 18-19.

FIG. 21 is a perspective view of an eighth embodiment of an apparatus in accordance with the invention. In this embodiment, the apparatus is a scooter **8000** that is propelled by driving two pedals **8002, 8004** upward and downward. The pedals **8002, 8004** are adapted to receive a portion of a user's body weight when each of the user's feet is placed on a respective pedal **8002, 8004**. The pedals **8002, 8004** are adapted to move

between an initial position and a depressed position. The scooter **8000** also includes a geartrain or transmission assembly **8006** oriented towards the front portion of the scooter **8000** that translates downward force on the pedals **8002, 8004** to a rotational force on a rear set of wheels **8008**. Note that the geartrain shown is by example only, and other configurations and devices can be utilized in accordance with various embodiments of the invention. A geartrain can include, but is not limited, chain type-drives, band type-drives, hydraulic-type drives, or other gear drives that translate a downward force into a rotational force.

The scooter **8000** also includes attachment devices **8010a, 8010b** in the front portion of the scooter **8000**, and attachment device **8010c** in the rear portion of the scooter **8000**. The attachment devices **8010a, 8010b, 8010c** are similar to those shown and described above as **5016a, 5016b, 5016c** in FIG. 14, and can operate in conjunction with other scooters with corresponding attachment devices to form a scooter train as shown in FIG. 22.

Referring back to FIG. 20, the scooter **8000** includes a T-shaped steering handle **8012** which mounts to a front wheel **8014** and a lower frame **8016**. The two pedals **8002, 8004** mount to a respective driving arm **8018, 8020** that connect to the transmission assembly **8006**. The driving arms **8018, 8020** cooperate with the transmission assembly **8006** so that when one pedal **8002** moves in an upward direction, the other pedal **8004** moves in an opposing, downward direction. The driving arms **8018, 8020** each mount to a first shaft **8022** via a respective one-way or overrunning clutch **8024, 8026**. A spring or leaf spring (not shown) mounts to each driving arm **8018, 8020** to provide an upward "return" force to the driving arm **8018, 8020** when the respective arm **8018, 8020** moves

to a depressed position. The upward "return" force moves the driving arm **8018, 8020** to the initial position to receive another downward force. Note that in this embodiment, the springs or leaf springs act as "recovery action" devices.

Downward forces applied to the pedals **8002, 8004** are transferred to rear set of wheels **8008** by the transmission assembly **8006**. The transmission assembly **8006** includes a drive gear **8032** mounted to the first shaft **8022**, an intermediate gear **8034** mounted to a second shaft **8036**, a first ratchet wheel **8038** mounted to the second shaft **8036**, a second ratchet wheel **8040** mounted to a rear axle **8042**, and a circular chain **8044** extended between the first ratchet wheel **8038** and second ratchet wheel **8040**. Downward forces transferred from the pedals **8002, 8004** to the overrunning clutches **8024, 8026** are transmitted to the drive gear **8032**. The drive gear **8032** transfers the force to the intermediate gear **8034**, and the force is further transmitted to the first ratchet wheel **8038**. The chain **8044** transfers the force to the second ratchet wheel **8040** and the rear set of wheels **8008** mounted to the rear axle **8042** turns accordingly. Other configurations of gears can be utilized for the transmission assembly in accordance with the invention.

A second one-way clutch or overrunning clutch **8046, 8048** in each wheel of the rear set of wheels **8008** permits the rear set of wheels **8008** to rotate faster than the rear axle **8042**. This type of freewheeling motion is similar to that described in the embodiments above.

An optional brake (not shown) can be mounted to the set of wheels **8008**, and a manual grip (not shown) to apply the brake can be connected to the handle **8012**. Those

skilled in the art will recognize the type of brake and manual grip that can be utilized in accordance with the invention.

The scooter **8000** shown in FIG. 21 operates in a similar manner as the apparatuses shown and described in FIGs. 14-17, FIGs. 18-19, and FIG. 20.

FIG. 22 is a scooter train in accordance with the invention. A scooter train **9000** is a combination of two or more scooters **9002, 9004, 9006, 9008** equipped with connection devices **9010** similar to those shown as **5016a, 5016b, 5016c** shown in FIG. 14 and also to those shown in FIGs. 20 and 21. The scooter train **9000** can be propelled by one or more users on any of the scooters, preferably by a user on the lead scooter **9002**. Depending on the combination of connection devices **9010** used, one or more of the users can control the direction of the scooter train **9000** by steering a respective scooter **9002, 9004, 9006, 9008**. In most cases, the lead scooter **9002** can control the direction of the scooter train **9000**. Note that the combination of scooters shown is shown by example only, and greater or lesser numbers of scooters can be used in a scooter train **9000**.

FIG. 23 is a flowchart for an exemplary embodiment of a method in accordance with the invention. In this embodiment, an apparatus such as a skateboard shown in FIGs. 1-5, 6, or 7-13 can be utilized to perform a method **10000** for propelling a platform. The method **10000** for propelling a platform begins at block **10002**.

Block **10002** is followed by block **10004**, in which a downward force is received on a first portion of the platform.

Block **10004** is followed by block **10006**, in which the downward force from the platform is translated to a rotational force on at least one wheel.

Block **10006** is followed by block **10008**, in which a return force is generated on the first portion of the platform.

Block **10008** is followed by block **10010**, in which a downward force is received on a second portion of the platform;

Block **10010** is followed by block **10012**, in which the downward force from the platform is translated to a rotational force on the wheel.

Block **10012** is followed by block **10014**, in which a return force on the second portion of the platform is generated.

Block **10014** is followed by block **10016**, in which a directional force on the platform is received.

Block **10016** is followed by block **10018**, in which the directional force is translated to the wheels to pivot a first set of wheels in a direction counter to a second set of wheels, wherein the platform moves in a lateral direction.

Block **10018** is followed by block **10020**, in which the method **10000** ends.

FIG. 24 is a flowchart for another embodiment of another method in accordance with the invention. In this embodiment, an apparatus such as a scooter shown in FIGs. 14-17, 18-19, 20, or 21 can be utilized to perform a method **11000** for propelling a scooter. The method **11000** for propelling a platform begins at block **11002**.

Block **11002** is followed by block **11004**, in which a downward force is received on a first pedal.

Block **11004** is followed by block **11006**, in which the downward force from the pedal is translated to a rotational force on at least one wheel.

Block **11006** is followed by block **11008**, in which a return force is generated on the first pedal.

Block **11008** is followed by block **11010**, in which a downward force is received on a second pedal.

Block **11010** is followed by block **11012**, in which the downward force from the second pedal is translated to a rotational force on the wheel.

Block **11012** is followed by block **11014**, in which a return force is generated towards the pedals, wherein the platform is propelled forward by the rotational force on the wheels.

Block **11014** is followed by block **11016**, in which the method **11000** ends.

While the above description contains many specifics, these specifics should not be construed as limitations on the scope of the invention, but merely as exemplifications of the disclosed embodiments. Those skilled in the art will envision many other possible variations that within the scope of the invention as defined by the claims appended hereto.